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SCHWEGMAN, LUNDBERG & WOESSNER, P.A.
P.O. BOX 2938
MINNEAPOLIS, MN 55402

EXAMINER	
LEUNG, JENNIFER A	

ART UNIT	PAPER NUMBER
1797	

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/524,325	ALLAM ET AL.
	Examiner	**Art Unit**
	JENNIFER A. LEUNG	1797

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _06 January 2009_.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-19,21-25 and 27-29_ is/are pending in the application.

4a) Of the above claim(s) _1-18_ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _19,21-25 and 27-29_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on January 6, 2009 has been entered.

Status of the Claims

2. Applicant's amendment filed on January 6, 2009 has been carefully considered. Claims 1-18 are withdrawn from consideration. Claims 20 and 26 are cancelled. Claims 19, 21-25 and 27-29 are under consideration.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

3. Claim 28 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

The limitation of, "the syngas generation system comprises… an autothermal reformer ("ATR") in which the gas comprising methane reacts with the oxidant gas comprising oxygen," does not appear to be supported by the original disclosure.

In particular, Applicant's specification states that the syngas generation system comprises a partial oxidation reactor ("POX") combined with an enhanced heat transfer reactor ("EHTR"). See, e.g., page 18, second and third paragraphs; page 15, last paragraph.

The autothermal reformer is only briefly mentioned in the background or prior art discussion, and does not appear to form part of Applicant's invention. See, e.g., page 1, third paragraph to page 2, first paragraph. In fact, the specification appears to suggest that the syngas generation system should not comprise an autothermal reformer. See, e.g., page 5, last paragraph to page 6, first paragraph.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 19, 22-24 and 27-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over <u>Banquy '096</u> (US 4,782,096) in view of <u>Fong et al.</u> (US 5,496,859), <u>Banquy '130</u> (US 4,888,130), <u>Davis et al.</u> ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*,

February 1980, pages 72-79) and McNeil et al. (US 6,073,461).

Regarding claim 19, Banquy '096 (FIGs. 1-3) discloses an apparatus comprising:

a syngas generation system (i.e., comprising a "primary steam reforming" zone and a "secondary oxygen reforming" zone; in detail in FIG. 2) generating syngas **11** by reaction of methane **2** with steam **5** and oxygen **8**, (see, e.g., column 6, line 19 to column 9, line 3);

a syngas conversion system (i.e., a "synthesis loop"; in detail in FIG. 3) converting syngas **11** into higher molecular weight hydrocarbon compounds or oxygenates **14** and producing an offgas **15**, (see, for example, column 9, lines 13-46); and

a physical separation zone for separating the various components contained in the offgas **15** produced by the syngas conversion system.

i) For the syngas generation system, Banquy '096 fails to disclose the instantly claimed syngas generation system, in which the heat for endothermic syngas generation is produced by exothermic reaction of the gas comprising methane with the oxidant gas.

Fong et al., however, teaches a syngas generation system (see FIG. 1; column 3, line 65 to column 5, line 34) configured to generate syngas comprising carbon monoxide and hydrogen by reaction of a gas comprising methane (i.e., in stream **1**) with steam (i.e., in stream **5**) and oxygen (i.e., in stream **2**), wherein heat for the endothermic syngas generation (i.e., conducted in the tube side of the steam reforming catalytic reactor) is produced by exothermic reaction of the gas comprising methane with oxygen (i.e., the product stream from the partial oxidation reactor or gasifier is passed to the shell side of the steam reforming catalytic reactor, to provide heat to the tube side reaction; see column 4, lines 26-38). Fong et al. specifically teaches that such a system is an improvement over the prior art syngas generation system in U.S. Pat. No. 4,888,130,

or Banquy '130 (see Fong et al.: column 2, lines 6-53). It is noted that the syngas generation system in Banquy '130 (see figure) is the same as the syngas generation system in Banquy '096 (see FIG. 2).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to substitute the syngas generation system of Fong et al. for the syngas generation system of Banquy '096, because the syngas generation system of Fong et al. is able to produce stoichiometric ratioed synthesis gas at elevated pressures, while minimizing or eliminating the need for external compression (see, e.g., column 2, lines 45-53; column 3, lines 7-20 and 40-52).

ii) For the physical separation zone, Banquy '096 discloses that "[a]ny physical separation process can be used" in the physical separation zone and, in particular, "[t]he physical separation can… be achieved by cryogenic techniques, or distillation at low temperature, such as outlined in *Chemical Engineering Progress*, February 1980, pages 72-79 …" to Davis et al. (see column 9, lines 55-68).

Looking at the cited publication, Davis et al. teaches a physical separation zone (see Figure 2, showing the "methane wash approach") that separates a feed gas into a hydrogen product, a CO product, and a fuel; wherein the separation zone comprises: a cryogenic separation system (i.e., a methane wash column) that produces the hydrogen product (i.e., in the overhead) and a first cryogenic liquid stream comprising carbon monoxide (i.e., in the bottoms); and a cryogenic distillation column (i.e., CO/CH_4 fractionator) for separating carbon monoxide from the first cryogenic liquid stream to produce the CO product (i.e., in the overhead) and substantially carbon monoxide-free cryogenic liquid (i.e., in the bottoms), usable as fuel; (see also page 74, beginning of column 2, to page 75, end of column 1).

The collective teaching of Banquy '096 and Davis et al., however, is silent as to the physical separation zone having the instantly claimed configuration of a first liquid methane wash column, a second liquid methane wash column, a nitrogen rejection column, and a cryogenic distillation column.

McNeil et al. teaches a physical separation zone (see Figure 1; generally, column 4, line 7 to column 7, line 67) that, similarly to Davis et al., separates a feed gas **1** into a hydrogen product **54**, a CO product **44**, and a fuel **53**; wherein the separation zone comprises:

a first liquid methane wash column (i.e., a column **8**, supplied with liquid methane from line **36** and pump **38**) configured to separate hydrogen from the feed gas **1** to produce a separated hydrogen product that is substantially free of carbon monoxide (i.e., leaving as overhead, via line **12** to the hydrogen rich product line **54**) and a first cryogenic liquid comprising carbon monoxide and residual hydrogen (i.e., leaving as bottoms, via line **13**), (see column 5, line 56 to column 6, line 2; column 6, lines 54-56);

a second liquid methane wash column (i.e., a column **15**, supplied with liquid methane from line **14**) configured to separate the residual hydrogen from the first cryogenic liquid (i.e., fed by line **13**) to produce separated hydrogen usable as a fuel by-product (i.e., leaving as overhead, via line **19** to the fuel gas product line **53**) and a second cryogenic liquid comprising carbon monoxide (i.e., leaving as bottoms, via line **18**), (see column 6, lines 7-24; column 7, lines 21-67);

a nitrogen rejection column (i.e., nitrogen-separation fractionation column **22**) configured to separate nitrogen (i.e., leaving as overhead, in line **25**) from said second cryogenic liquid (i.e., fed by line **18**) to produce a third cryogenic liquid (i.e., leaving as bottoms, in line **26**), (see

column 6, lines 25-37); and

a cryogenic distillation column (i.e., a methane-separation fractionation column **32**) configured to separate carbon monoxide from said third cryogenic liquid (i.e., fed by line **26**) to produce separated carbon monoxide product (i.e., leaving as overhead, in line **35** to the CO product line **44**) and a substantially carbon monoxide-free cryogenic liquid (i.e., leaving as bottoms, in line **36**), (see column 6, lines 38-53).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to select the physical separation zone as taught by McNeil et al. for the physical separation zone in the modified apparatus of Banquy '096, because any physical separation process can be used, and a physical separation process employing cryogenic techniques or distillation at low temperature is specifically suggested as being suitable (see Banquy '096: column 9, lines 55-65). Like the cited publication to Davis et al., the physical separation zone of McNeil et al. separates a feed gas into a hydrogen product, a CO product, and a fuel. However, one having ordinary skill in the art would have been motivated to provide the physical separation zone of McNeil et al. in the modified apparatus of Banquy '096 because, unlike conventional cryogenic techniques (such as Davis et al.), the separation zone of McNeil et al. further removes nitrogen contaminant from the carbon monoxide product, which would be desirable for environmental and processing reasons (see McNeil et al.: column 1, lines 16-35).

Regarding claim 22, as noted above, the modified apparatus of Banquy '096 produces a carbon monoxide product via physical separation (see McNeil et al.: CO product stream in conduit **44**; FIG. 1). Furthermore, carbon monoxide is a considered a reactant in the syngas conversion system, i.e., in the synthesis of hydrocarbons or oxygenates (see Banquy '096:

column 1, lines 10-18 and 20-33). Accordingly, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide conduit means for feeding the carbon monoxide product to the syngas conversion system in the modified apparatus of Banquy '096, because one having ordinary skill in the art would have recognized the carbon monoxide product to be a readily available source of reactant for the syngas conversion system. Also, the recycling of un-reacted reactants or products for further processing, which advantageously reduces material costs and environmental impact, would have been considered well known to those having ordinary skill in the engineering art.

Regarding claim 23, Banquy '096 further discloses that the residual gas stream contains argon (see column 9, lines 46-54). Thus, the modified apparatus of Banquy '096 inherently comprises conduit means for removing an argon-enriched stream from a location in the region of high argon concentration in the cryogenic distillation column (i.e., via the bottoms of the methane-separation fraction column **32**, as taught by McNeil et al.; see column 5, lines 10-13).

Regarding claim 24, as noted above, the modified apparatus of Banquy '096 produces a liquid methane product via physical separation (see McNeil et al.: e.g., liquid methane in line **36**, discharged via conduit **53**; FIG. 1). Furthermore, Fong et al. teaches that the syngas generation system (see FIG. 1; column 3, line 65 to column 4, line 5) consumes methane, e.g., as a feedstock for reforming, or as a fuel for the fired heater. Accordingly, it would have been obvious for one of ordinary skill in the art at the time the invention was made to provide conduit means for feeding the methane product to the syngas generation system in the modified apparatus of Banquy '096, i.e., as a feedstock for reforming or a fuel for the fired heater, because one having ordinary skill in the art would have recognized the methane product to be a readily

available source of reactant or fuel for the syngas generation system. Also, the recycling of un-reacted reactants or products for further processing, which advantageously reduces material costs and environmental impact, would have been considered well known to those having ordinary skill in the engineering art.

Regarding claim 27, Banquy '096 (see column 9, lines 47-54, with emphasis added) further discloses,

> "*The purge gas (stream **15**) extracted from the synthesis loop is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be mixed with the raw synthesis gas to form the final synthesis gas,* and a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary steam reformer."

As seen in FIGs. 1, 4 and 5, the apparatus further comprises conduit means **12** for removing a portion of the separated hydrogen product, in order to recycle the hydrogen to the syngas conversion system (i.e., the synthesis loop) for generation of higher molecular weight hydrocarbon compounds or oxygenates **14**. Please note that the recitation of a particular molar concentration of helium within the separated hydrogen product stream is considered a process limitation that adds no further patentable weight to the apparatus claim.

Regarding claim 28, Fong et al. teaches a partial oxidation reactor for conducting the reaction of methane with the oxidant gas (see column 4, lines 6-25), and an enhanced heat transfer reformer for conducting the reaction of methane with the steam (see column 4, lines 25-56; also, column 5, lines 23-51).

Regarding claim 29, Banquy '096 discloses that the syngas conversion system comprises at least one FT reactor (i.e., a synthesis converter **SC**, for reacting hydrogen with carbon

monoxide, carbon dioxide or mixtures of these carbon oxides to yield organic compounds, such as a hydrocarbon, a mixture of hydrocarbons, an oxygenated compound, or any mixture thereof (see FIG. 3; see column 9, lines 4-46; also, column 1, lines 10-17, lines 20-34).

5. Claim 21 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy '096 (US 4,782,096) in view of Fong et al. (US 5,496,859), Banquy '130 (US 4,888,130), Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages 72-79) and McNeil et al. (US 6,073,461), as applied to claim 19 above, and further in view of Ireland et al. (US 4,044,063).

The collective teaching of Banquy '096, Fong et al., Banquy '130, Davis et al. and McNeil et al. is silent as to the apparatus further comprising a hydrogenation system.

Ireland et al. (FIG. 1; see, for example, column 8, line 15 to column 9, line 3) teaches a hydrogenation system (e.g., hydrotreating unit **56**; or hydrodewaxing unit **62**) for hydrogenating a fraction of the higher molecular weight hydrocarbon compounds **54**, **60** produced by a syngas conversion system (i.e., in F-T synthesis zone **4**).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a hydrogenation system to the modified apparatus of Banquy '096, on the basis of suitability for the intended use thereof, because the provision of a hydrogenation system helps maximize the production of further liquid hydrocarbon products from the Fischer-Tropsch reaction products stream, as taught by Ireland et al.

6. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Banquy '096 (US 4,782,096) in view of Fong et al. (US 5,496,859), Banquy '130 (US 4,888,130), Davis et al. ("Cryogenics for Syngas Processing", *Chemical Engineering Progress*, February 1980, pages

72-79) and McNeil et al. (US 6,073,461), as applied to claim 19 above, and further in view of Keller (US 4,650,814).

Banquy '096 discloses that "[a]ny physical separation process can be used" in the physical separation zone and, in particular, "[a]nother physical separation for this purpose is the membrane separation process, which is described in Hydrocarbon Processing May 1980 pages 115-118, and July 1980 pages 65-67," (column 9, lines 55-68).

The collective teaching of Banquy '096, Fong et al., Banquy '130, Davis et al. and McNeil et al., however, is silent as to the provision of a membrane separation system, for removing helium from the separated hydrogen product.

Keller (FIG. 3) teaches a membrane separation system **325** for removing inert gases **344** such as helium (see column 7, lines 6-17) from a separated hydrogen product stream **330**. (see column 13, line 10 to column 14, line 34; see column 15, lines 10-36; see also FIG. 1, column 8, line 14 to column 9, line 8).

It would have been obvious for one of ordinary skill in the art at the time the invention was made to further provide a membrane separation system in the modified apparatus of Banquy '096, on the basis of suitability for the intended use thereof, because the membrane separation system enables the generation of a high purity hydrogen stream for use as a recycle, while minimizing the amount of inert compound build-up in the system by separating and removing any inert gases, such as helium, from the system, as taught by Keller.

Response to Arguments

7. Applicant's arguments (see page 8, last paragraph, to page 9, second paragraph) with respect to the feature of a syngas generation system, "wherein heat for endothermic syngas

generation is produced by exothermic reaction of the gas comprising methane with the oxidant gas," have been fully considered. Applicant's arguments, however, are moot in view of the new grounds of rejection, made in view of the newly discovered prior art to Fong et al.

Applicant (at page 9, third paragraph) further argues,

> "… the Office Action asserts that "Banquy discloses that '[a]ny physical separation process can be used' in the physical separation zone" and cites Davis and McNeil to provide the separated carbon monoxide product recited in claim 19. However, the cited portions of Banquy appear to relate to separation of only hydrogen from its purge gas. For example, Banquy states that the purge gas "is subjected to a physical separation to split it into a hydrogen-rich stream, a portion of which will be mixed with raw synthesis gas to form the final synthesis gas and a residual gas stream which contains essentially methane, carbon oxides, argon, nitrogen and some hydrogen, and which can be used as fuel in the primary stream [sic] reformer" (column 9, lines 47-54), and that "essentially all the carbon monoxide in the purge gas reacts with steam, in the presence of a shift conversion catalyst, to form carbon dioxide and hydrogen" (column 10, lines 4-7). Thus, it is believed that the cited statement of Banquy that "[a]ny physical separation process can be used" refers to only separation of hydrogen, and by providing that "essentially all the carbon monoxide in the purge gas reacts with steam", Banquy in fact teaches away from producing the separated carbon monoxide product as recited in claim 19..."

The Examiner respectfully disagrees.

With respect to Applicant's argument that Banquy '096 refers only to the separation of hydrogen (and not the separation of other gas components, such as carbon monoxide), it is noted that Banquy '096 specifically directs the reader to the cryogenic separation techniques of Davis et al. (i.e., the Chemical Engineering Progress citation; see column 9, lines 61-65). Looking to the Davis et al. publication, the physical separation zone not only separates a hydrogen product from a feed gas, but also a CO product (and a fuel product) as separate gas streams (see Figure

2). Accordingly, one having ordinary skill in the art would have understood that the physical separation zone is not limited to the separation of hydrogen only, but may also include the separation of the purge gas into other component streams, including a carbon monoxide stream.

With respect to Applicant's argument that Banquy '096 teaches away from producing a separated carbon monoxide product, since "essentially all the carbon monoxide in the purge gas reacts with steam, in the presence of a shift conversion catalyst, to form carbon dioxide and hydrogen", it is noted that this feature is found in the alternative embodiment of FIG. 4. The rejections, however, are made in reference to the embodiment of FIG. 1, as evidenced by the citations made in the previous Office Action (namely, at column 9, lines 55-68). The Examiner therefore emphasizes that the claims are rejected in view of the embodiment shown in FIG. 1 of Banquy '096, which does not include a shift conversion reactor.

Lastly, Applicant's arguments (at page 10, third and fourth paragraphs) with respect to claims 22 and 24 have been fully considered, but they are now moot in view of the new grounds of rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JENNIFER A. LEUNG whose telephone number is (571) 272-1449. The examiner can normally be reached on 9:30 am - 5:30 pm Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola can be reached on (571) 272-1444. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent

Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Jennifer A. Leung/
Primary Examiner, Art Unit 1797